Name _____

More Complicated Inheritance Patterns

INCOMPLETE DOMINANCE: Remember, here the different alleles cause a blended new phenotype.

1. In four o'clock flowers, red (R) is incompletely dominant over white (W).
Cross two pink (RW) parents. Write the genotypes of the parents, show a Punnett square, complete the genotypic and phenotypic ratios of the offspring, and determine the probabilities indicated.

	R	W
R	RR	RW
W	RW	WW

Genotypes of parents: RW x RW

Genotypic ratio: 1 RR: 2 RW: 1 WW

Phenotypic ratio: 1 red: 2 pink: 1 white

Probability offspring is:
Red 1/4
White 1/4
Pink 1/2

2. Now cross a red flower with a white flower. Write the genotypes of the parents, show a Punnett square, complete the genotypic and phenotypic ratios of the offspring, and determine the probabilities.

	W	W
R	RW	RW
R	RW	RW

Genotypes of parents: RR x WW

Genotypic ratio: 100% RW

Phenotypic ratio: 100% pink

Probability offspring is:
Red 0
White 0
Pink 100%

3. What cross would result in a phenotypic ratio of 1 red: 2 pink: 1 white?
Show a Punnett square to support your answer.

Genotypes of parents RW x RW

	R	W
R	RR	RW
W	RW	WW

4. What cross would result in a phenotypic ratio of 1 red: 1 pink?
Show a Punnett square to support your answer.

Genotypes of parents RR x RW

	R	W
R	RR	RW
R	RR	RW

5. In squash plants, round squash (R) are incompletely dominant over long squash (L).
Cross 2 oval (RL) parents. Write the genotypes of the parents, show a Punnett square, complete the genotypic and phenotypic ratios of the offspring, and determine the probabilities indicated.

	R	L
R	RR	RL
L	RL	LL

Genotypes of parents: RL x RL

Genotypic ratio: 1 RR: 2 RL: 1 LL

Phenotypic ratio: 1 round: 2 oval: 1 long

Probability offspring is:
Round 1/4
Long 1/4
Oval 1/2

6. Now cross a round squash with an oval squash. Write the genotypes of the parents, show a Punnett square, complete the genotypic and phenotypic ratios of the offspring, and determine the probabilities.

	R	L
R	RR	RL
R	RR	RL

Genotypes of parents: RR x RL

Genotypic ratio: 1 RR: 1 RL

Phenotypic ratio: 1 round: 1 oval

Probability offspring is:
Round 1/2
Long 0
Oval 1/2

7. What cross would result in offspring that are all oval?
Show a Punnett square to support your answer.

Genotypes of parents RR x LL

	L	L
R	RL	RL
R	RL	RL

8. What cross would result in a phenotypic ratio of 1 oval: 1 long?
Show a Punnett square to support your answer.

Genotypes of parents RL x LL

	L	L
R	RL	RL
L	LL	LL

CODOMINANCE: Remember, here two alleles can both be dominant and express or show themselves equally.

9. In chickens, black feathers (BB) are codominant with white feathers (WW).
The heterozygous genotype (BW) results in erminette, or speckled black AND white feathers.
Cross two erminette chickens. Write the genotypes of the parents, show a Punnett square, complete the genotypic and phenotypic ratios of the offspring, and determine the probabilities indicated.

	B	W
B	BB	BW
W	BW	WW

Genotypes of parents: BW x BW

Genotypic ratio: 1 BB: 2 BW: 1 WW

Phenotypic ratio: 1 black: 2 erminette: 1 white

Probability offspring is:
Black 1/4
White 1/4
Erminette 1/2

10. Now cross an erminette chicken with a white chicken. Write the genotypes of the parents, show a Punnett square, complete the genotypic and phenotypic ratios of the offspring, and determine the probabilities indicated.

	W	W
B	BW	BW
W	WW	WW

Genotypes of parents: BW x WW

Genotypic ratio: 1 BW: 1 WW

Phenotypic ratio: 1 erminette: 1 white

Probability offspring is:
Black 0
White 1/2
Erminette 1/2

11. What cross would result in a phenotypic ratio of 1 black: 1 erminette?
Show a Punnett square to support your answer.

Genotypes of parents BB x BW

	B	W
B	BB	BW
B	BB	BW

12. What cross would result offspring that are all erminette?
Show a Punnett square to support your answer.

Genotypes of parents BB x WW

	W	W
B	BW	BW
B	BW	BW

13. In shorthorn cattle red coat color (RR) is codominant with white coat color (WW).
The heterozygous genotype (RW) results in a roan, or red AND white coat color.
Cross a red bull (male) with a white cow (female). Write the genotypes of the parents, show a Punnett square, complete the genotypic and phenotypic ratios of the offspring, and determine the probabilities.

	W	W
R	RW	RW
R	RW	RW

Genotypes of parents: RR x WW

Genotypic ratio: 100% RW

Phenotypic ratio: 100% roan

Probability offspring is:
Red 0
White 0
Roan 100%

14. Now cross a roan bull with a red cow. Write the genotypes of the parents, show a Punnett square, complete the genotypic and phenotypic ratios of the offspring, and determine the probabilities.

	R	R
R	RR	RR
W	RW	RW

Genotypes of parents: RW x RR

Genotypic ratio: 1 RR: 1 RW

Phenotypic ratio: 1 red: 1 roan

Probability offspring is:
Red 1/2
White 0
Roan 1/2

15. What cross would result in a phenotypic ratio of 1 roan: 1 white?
Show a Punnett square to support your answer.

Genotypes of parents RW x WW

	W	W
R	RW	RW
W	WW	WW

16. What cross would result in a phenotypic ratio of 1 red: 2 roan: 1 white?
Show a Punnett square to support your answer.

Genotypes of parents RW x RW

	R	W
R	RR	RW
W	RW	WW

MULTIPLE ALLELES: Many traits involve more than just two alleles. For example, in humans, ABO blood types are determined by three alleles; A, B, and O. (Furthermore, A and B are codominant over the recessive allele O.)

17. Blood types display codominance in the form of multiple alleles. Complete the following crosses. Show a Punnett square and then write the genotypic and phenotypic ratios of the offspring for each.
   (a) Type A (homozygous) x Type B (homozygous)
   (b) Type A (homozygous) x Type B (heterozygous)
   (c) Type A (heterozygous) x Type B (homozygous)

a. ♂ I^AI^A X I^BI^B ♀

AB	AB
AB	AB

Genotype Ratio:
100% I^AI^B

Phenotype Ratio:
100% AB

b. ♂ I^AI^A X I^Bi ♀

AB	Ai
AB	Ai

Genotype Ratio:
1 I^AI^B: 1 I^Ai

Phenotype Ratio:
1 AB : 1 A

c. ♂ I^Ai X I^BI^B ♀

AB	AB
Bi	Bi

Genotype Ratio:
1 I^AI^B: 1 I^Bi

Phenotype Ratio:
1 AB : 1 B

18. Complete the following crosses. Show a Punnett square and then write the genotypic and phenotypic ratios of the offspring for each.
   (a) Type AB x Type AB
   (b) Type AB x Type O
   (c) Type A (heterozygous) x Type B (heterozygous)

a. ♂ I^AI^B X I^AI^B ♀

AA	AB
AB	BB

Genotype Ratio:
1 I^AI^A: 2 I^AI^B: 1 I^BI^B

Phenotype Ratio:
1 A : 2 AB : 1 B

b. ♂ I^AI^B X ii ♀

Ai	Ai
Bi	Bi

Genotype Ratio:
1 I^Ai: 1 I^Bi

Phenotype Ratio:
1 A : 1 B

c. ♂ I^Ai X I^Bi ♀

AB	Ai
Bi	ii

Genotype Ratio:
1 I^AI^B : 1 I^Ai: 1 I^Bi: 1 ii

Phenotype Ratio:
1 AB: 1 A : 1 B : 1 O

19. Could a parent with type AB blood and a parent with type O blood have a child with type O blood? Explain why or why not. Draw a Punnett square to support your answer.
NO …offspring will all be A or B I^AI^B X ii

Ai	Ai
Bi	Bi

POLYGENIC: This is a situation where two or more gene pairs, probably on different chromosomes, work together to create many variations for a specific trait.
Most human traits are thought to be polygenic.

In humans, at least 8 different genes determine eye color, and is thus considered polygenic.
For simplicity, consider the influence of 3 genes; A, B, and C.
The greater the number of dominant alleles, the darker the eye color.

20. Cross a male with the genotype AaBBCc with a female with the genotype AABbcc

List the genotypes of the gametes produced by:

- The father: ABC, ABc, aBC, aBc
- The mother: ABc, Abc

Create a Punnett square.
Then list the genotypes of each child in order from lightest to darkest eye coloration based on the number of dominant alleles.

	ABc	Abc
ABC	AABBCc 5	AABbCc 4
ABc	AABBcc 4	AABbcc 3
aBC	AaBBCc 4	AaBbCc 3
aBc	AaBBcc 3	AaBbcc 2

Lightest	AaBbcc (2 dominant alleles)
	AaBBcc (3 dominant alleles)
	AaBbCc (3 dominant alleles)
	AABbcc (3 dominant alleles)
	AaBBCc (4 dominant alleles)
	AABBcc (4 dominant alleles)
	AABbCc (4 dominant alleles)
Darkest	AABBCc (5 dominant alleles)

In parakeets, two pairs of alleles (Yellow and Blue) work together to determine a bird's color.
Parakeets that are **green** in color are determined by the genotype B __ Y __.
Parakeets that are **blue** in color are determined by the genotype B __ yy.
Parakeets that are **yellow** in color are determined by bbY __.
Parakeets that are **white** in color only exist as the genotype bbyy.

List the possible genotypes for each of the colors given.

Green 1. BBYY 2. BbYy 3. BBYy 4. BbYY

Blue: 1. BByy 2. Bbyy

Yellow: 1. bbYY 2. bbYy

White: 1. bbyy

Cross the following parakeets. Write the genotypes of the parents, complete a Punnett square, and write the fraction of offspring that could have each color.

21. 2 heterozygous green parakeets ♂ BbYy X BbYy ♀

9/16 green
3/16 blue
3/16 yellow
1/16 white

	BY	By	bY	by
BY	BBYY	BBYy	BbYY	BbYy
By	BBYy	BByy	ByYy	Bbyy
bY	BbYY	BbYy	bbYY	bbYy
by	ByYb	Bbyy	bbYy	bbyy

22. Heterozygous yellow x homozygous yellow ♂ bbYy X bbYY ♀

0 green
0 blue
100% yellow
0 white

	bY			
bY	bbYY			
by	bbYy			

23. Homozygous blue x heterozygous yellow ♂ BByy X bbYy ♀

1/2 green
1/2 blue
0 yellow
0 white

	bY	by		
By	BbYy	Bbyy		

24. Heterozygous blue x white ♂ Bbyy X bbyy ♀

0 green
1/2 blue
0 yellow
1/2 white

	by			
By	Bbyy			
by	bbyy			

25. Homozygous yellow x heterozygous blue ♂ bbYY X Bbyy ♀

1/2 green
0 blue
1/2 yellow
0 white

	By	by		
bY	BbYy	bbYy		